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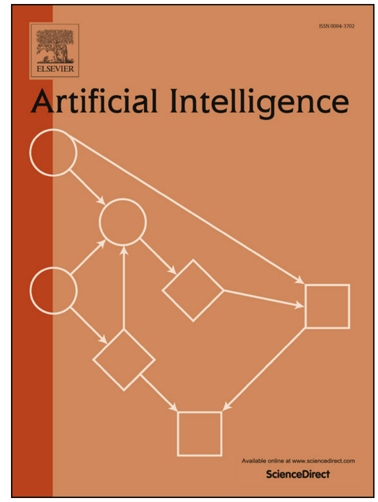

Thick Set Inversion

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Thick Set Inversion

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Abstract

This paper deals with the set inversion problem $\mathbb{X} = \mathbf{f}^{-1}(\mathbb{Y})$ in the case where the function $\mathbf{f} : \mathbb{R}^n \to \mathbb{R}^m$ and the set $\mathbb{Y}$ are both uncertain. The uncertainty is treated under the form of intervals. More precisely, for all $\mathbf{x}$, $\mathbf{f}(\mathbf{x})$ is inside the box $[\mathbf{f}](\mathbf{x})$ and the uncertain set $\mathbb{Y}$ is bracketed between an inner set $\mathbb{Y}^{\subset}$ and an outer set $\mathbb{Y}^{\supset}$. The introduction of new tools such as *thick intervals* and *thick boxes* will allow us to propose an efficient algorithm that handles the uncertainty of sets in an elegant and efficient manner. Some elementary test-cases that cannot be handled easily and properly by existing methods show the efficiency of the approach.

Keywords: Set-Membership methods, Interval Analysis, Constraint programming, Uncertainty.

1. Introduction

Interval-based methods [1, 2] combined with constraint propagation [3, 4, 5] have been shown to be very efficient to deal with continuous constraint satisfaction problems (see, *e.g.*, [6, 7, 8]) and global optimization [9]. A specific and important constraint satisfaction problem is *set inversion* [10] which can also be interpreted as the inversion of a set-membership constraint [11]. Given a function $\mathbf{f} : \mathbb{R}^n \to \mathbb{R}^m$ and a set $\mathbb{Y} \subset \mathbb{R}^m$, set inversion aims at bracketing from inside and outside the set

$$\mathbb{X} = \mathbf{f}^{-1}(\mathbb{Y}). \tag{1}$$

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